RTCA Special Committee 186, Working Group 3

ADS-B 1090 MOPS, Revision A

Meeting #10

Action Item 9-8
Simulation Results, ATCRBS Fruit at Different Power Levels

Presented by William Harman

SUMMARY

During our January meeting it was proposed to try changing the bench test condition from multiple ATCRBS fruit all at the same power level to a test using different ATCRBS power levels. Action item 9-8 was assigned for this issue. We have made use of a detailed pulse-level simulation to assess performance under these conditions. The results tend to support the original proposal. The results indicate that such tests can be used as a better way of insuring effective performance of an Extended Squitter receiver.

Simulation Results, ATCRBS Fruit at Different Power Levels

William Harman

PURPOSE

We are considering different possible bench tests in order to reveal the performance difference between the LDPU and the techniques in Appendix I. In particular, we are considering making the ATCRBS fruit interference have different power levels.

At our January meeting, we suggested that the tests in ATCRBS fruit should be done about 12 dB about MTL. Accordingly, we began our work on this action item by determining the relationship between the receiver threshold and MTL, which is defined to be the signal power level at which reception is 90%. From this work we determined that MTL is approximately 4 dB above the threshold, except when using a very low threshold near the receiver noise level. Therefore, for the conditions that follow, we used threshold = -88 dBm, for which MTL = -84 dBm.

CONDITIONS

We ran four cases.

Case A: 3 ATCRBS fruit, powers = -76, -72, and -68 dBm (one curve)

Case B: 3 ATCRBS fruit, powers = -72 dBm for all three (one curve)

Case C: 5 ATCRBS fruit, powers = -80, -76, -72, -68, and -64 dBm (one curve)

Case D: 5 ATCRBS fruit, powers = -72 dBm for all five (one curve)

Other conditions are:

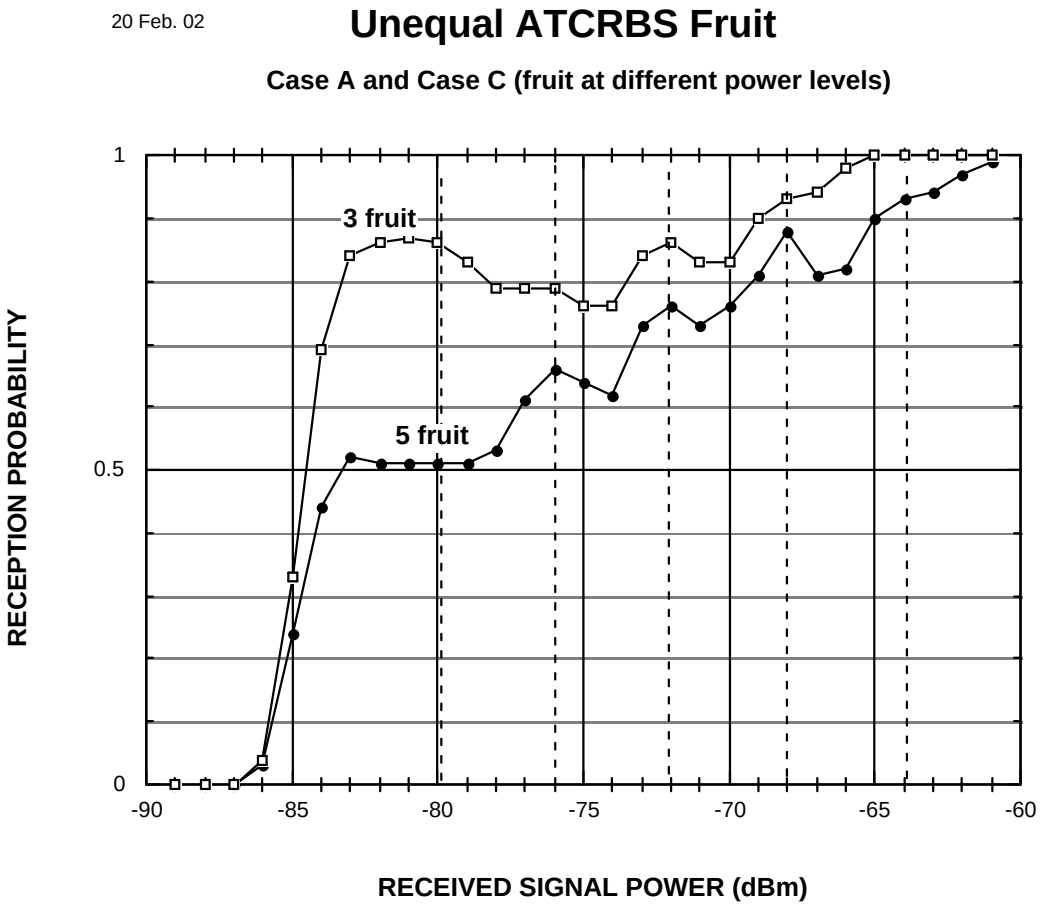
Receiver threshold = -88 dBm
Noise power = -100.7 dBm
Bandwidth = 8 MHz
8 samples per microsec.
4-4 decoding table, generated October 01.
Fruit timing: For each fruit, start time = random over -20 to +100 microsec., relative to the beginning of the signal.
Zero deviations in pulsewidths and frequencies.
1000 trials per point
Signal power, values spaced by 1 dB, between -90 and -55 dBm

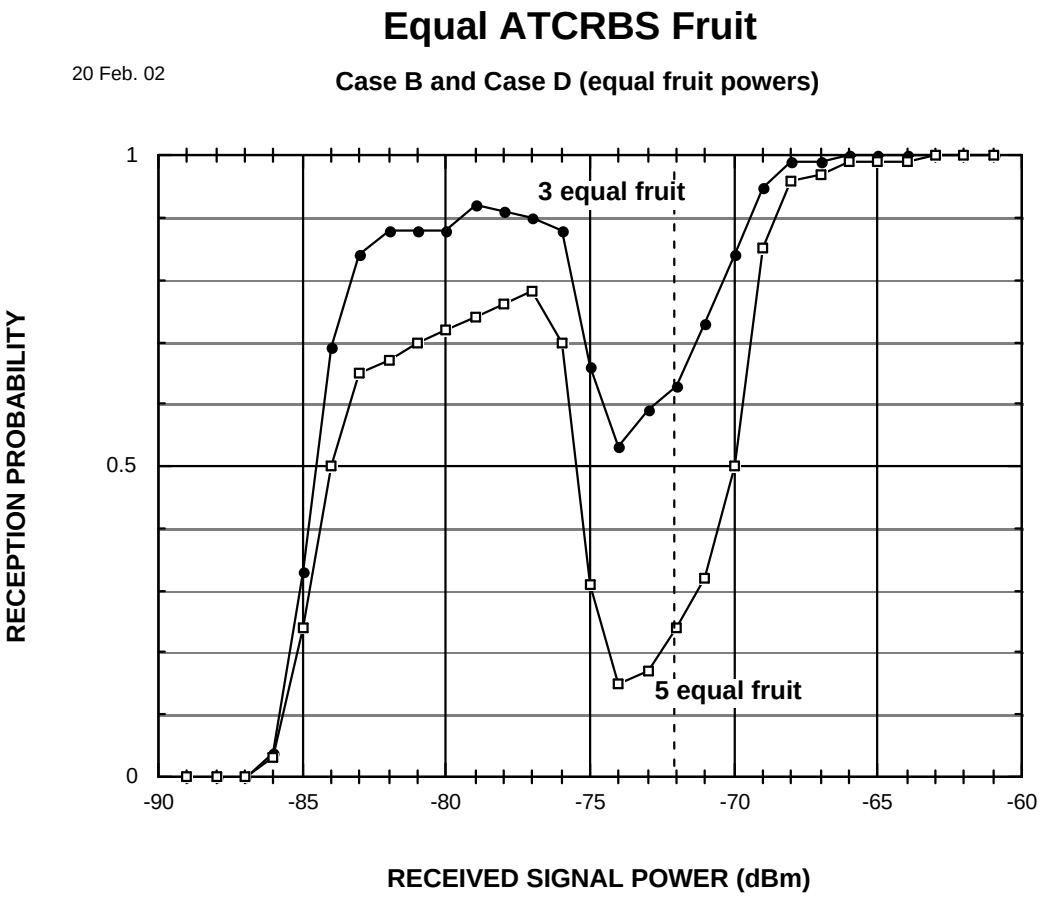
SIMULATION RESULTS

In studying these results, we began by checking the equal-fruit results against previous results. The results agree well. Since the conditions are not exactly the same, we

don’t expect exact agreement in the resulting probability values. From these results, we conclude that the simulation is performing well and is consistent with previous runs.

Following are the simulation results for 3 fruit and 5 fruit.





Quantitative comparison. Looking at the first plot suggests that a useful definition of average performance would be the average over 5 points: spaced by 4 dB, and centered at the average fruit power. The averages are as follows.

Appendix I performance,

for 3 fruit, average P(C) = 0.89

for 5 fruit, average P(C) = 0.75

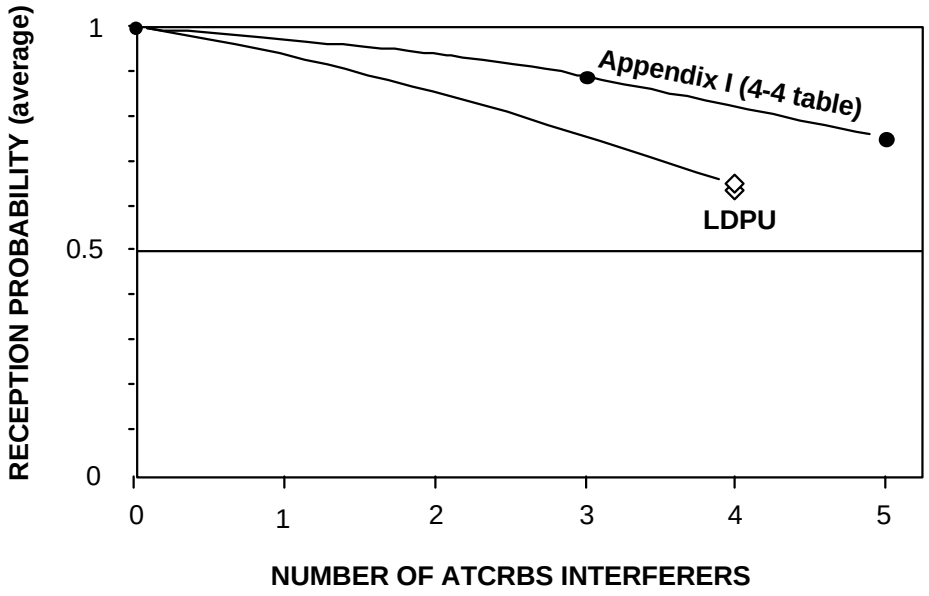
For comparison with these averages, following are the LDPU performance averages using nearly the same averaging. In a package of LDPU benchtest results, we have the following very similar cases.

LDPU performance

for I1,I2,I3,I4=-78,-73,-68,-63, average P(C) = 0.63

for I1,I2,I3,I4=-72,-67,-62,-57, average P(C) = 0.65

Note that the two assessments of LDPU performance are consistent with each other. Although the LDPU results apply to 4 fruit, whereas the Appendix I results apply to 3 and 5 fruit, we can compare them as in the following plot.



All of the data in this plot seem consistent. The Appendix I performance is seen to degrade in a reasonable manner as the number of ATCRBS fruit is increased. The LDPU performance is not as good as Appendix I, as we have come to expect, based on analysis of airborne data.

If we accept the data in this figure as a reasonable comparison between Appendix I and the LDPU, we conclude that the LDPU is significantly inferior. It is worse by approximately a factor of 2, when viewed as a departure from 100% reception probability.